

CLAIMS

What is claimed is:

- 1 1. A method for establishing a coarse-grained reservation of a lightpath traversing a
2 plurality of connected lightpath segments between source and destination nodes in an optical
3 switched network, comprising:
4 making a soft reservation of node resources supporting respective lightpath segments
5 from among the plurality of lightpath segments, the soft reservation of the node resources
6 corresponding to a scheduled time period for which the lightpath is requested to be reserved;
7 determining if adequate node resources are available for reservation during the
8 scheduled time period to support traversal of the entire lightpath; and
9 making a hard reservation of the node resources corresponding to the scheduled time
10 period if adequate node resources are determined to be available.
- 1 2. The method of claim 1, wherein the optical switched network comprises a photonic
2 burst switched (PBS) network.
- 1 3. The method of claim 2, wherein the optical burst switched network comprises a
2 wavelength-division multiplexed (WDM) PBS network.

1 4. The method of claim 1, further comprising storing resource reservation data at each
2 node, including resource reservation status indicia indicating whether a resource has a
3 corresponding soft or hard reservation.

1 5. The method of claim 4, further comprising:
2 passing a resource reservation request message between the nodes connected to the
3 lightpath segments in a downstream traversal of the lightpath, the resource reservation
4 request message including resource reservation information;
5 extracting the resource reservation information from the resource reservation request
6 message;
7 determining, based on existing resource reservation data for a given node, whether
8 adequate resources are available during the scheduled time period; and
9 making a soft reservation for a node resource the resource is determined to be
10 available for the scheduled time period.

1 6. The method of claim 5, wherein the resource reservation request message includes a
2 generalized multi-protocol label-switching (GMPLS)-based label defining transmission
3 parameters for a lightpath segment to which the GMPLS-based label corresponds.

1 7. The method of claim 6, wherein the GMPLS-based label includes at least one field
2 identifying an input wavelength employed for carrying signals over a lightpath segment
3 identified by the GMPLS-based label.

1 8. The method of claim 5, wherein the resource reservation request message comprises a
2 *Path* message having a format based on an extension to the RSVP-TE (ReSerVation Protocol
3 – Traffic Engineering) signaling protocol.

1 9. The method of claim 5, wherein the resource request information includes data
2 defining the scheduled time period.

1 10. The method of claim 5, further comprising:
2 passing a resource reservation response message between the nodes coupled to the
3 lightpath segments in an upstream traversal of the lightpath, the resource reservation request
4 message including resource reservation response information;
5 extracting, at each node, the resource reservation response information from the
6 resource reservation response message; and
7 changing, at each node, the soft reservation for the node resource to a hard
8 reservation.

1 11. The method of claim 10, wherein the resource reservation response message
2 comprises a *Resv* message having a format based on an extension to the RSVP-TE
3 (ReSerVation Protocol – Traffic Engineering) signaling protocol.

1 12. The method of claim 1, further comprising:
2 building a list of potential lightpaths between the source and destination nodes;
3 selecting a first potential lightpath in the list;

4 determining if sufficient resources are available to reserve node resources supporting
 5 lightpath segments defined by the first potential lightpath for the scheduled time period; and
 6 processing a next potential lightpath in the list to determine if sufficient resources are
 7 available to reserve node resources supporting lightpath segments defined by the next
 8 lightpath for the scheduled time period if it is determined that resources supporting the
 9 lightpath segments of the first potential lightpath are insufficient; and
 10 repeating the previous operation for subsequent next potential lightpaths in the list
 11 until either a lightpath having sufficient resources is identified or the list is exhausted.

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1 13. The method of claim 12, further comprising prioritizing the potential lightpaths in the
 2 list based on at least one transmission-related criteria.

1 14. The method of claim 13, further comprising dynamically reprioritizing the potential
 2 lightpaths in the list in response to a detected change in network transmission conditions.

1 15. The method of claim 13, wherein the potential lightpaths are prioritized based on
 2 traffic balancing considerations.

1 16. The method of claim 13, further comprising dynamically reprioritizing the potential
 2 lightpaths in the list in response to a detected change in network topology.

1 17. The method of claim 12, wherein the determination of whether adequate resources are
2 available at a given node comprises:

3 aggregating any existing reservations for the node resource corresponding to a
4 specified bandwidth and the scheduled time period to obtain an existing resource allocation;

5 adding the bandwidth percentage corresponding to a resource reservation request to
6 the existing resource allocation to obtain a requested allocation for the node resource;

7 determining if the requested allocation exceeds a threshold.

1 18. The method of claim 1, wherein a partial use of a node resource may be reserved.

1 19. The method of claim 18, wherein the partial use comprises a bandwidth percentage
2 use of a lightpath segment.

1 20. A switching apparatus for use in an optical switched network, comprising:

2 optical switch fabric, having at least one input fiber port and at least one output fiber
3 port; and

4 a control unit, operatively coupled to control the optical switch fabric, including at
5 least one processor and a first storage device operatively coupled to said at least one
6 processor containing machine-executable instructions, which when executed by said at least
7 one processor perform operations, including:

8 receiving a resource reservation request from a first node, said resource
9 reservation request including data pertaining to a first lightpath segment between the
10 first node and the switching apparatus, which comprises a second node, and a

11 scheduled time period for which resources for the switching apparatus are requested
12 to be reserved; and
13 making a soft reservation of resources supporting communication via the first
14 lightpath segment for the scheduled time period;
15 receiving a reservation response; and
16 changing the soft reservation of the resources supporting communication via
17 the first lightpath segment to a hard reservation to commit the resources for the
18 scheduled time period.

1 21. The switching apparatus of claim 20, wherein execution of the instructions further
2 performs the operation of storing resource reservation data on one of the first storage device
3 or a second storage device operatively coupled to said at least one processor, said resource
4 reservation data including resource reservation status indicia indicating whether a resource
5 has a corresponding soft or hard reservation.

1 22. The switching apparatus of claim 20, wherein the optical switched network comprises
2 a photonic burst switched (PBS) network.

1 23. The switching apparatus of claim 22, wherein the optical switched network comprises
2 a wavelength-division multiplexed (WDM) PBS network; and the optical switching fabric
3 provides switching of optical signals comprising different wavelengths carried over common
4 fibers that may be respectively coupled to said at least one input fiber port and said at least
5 one output fiber port.

1 24. The switching apparatus of claim 20, wherein the resource reservation request
2 message includes a generalized multi-protocol label-switching (GMPLS)-based label
3 defining transmission parameters for the first lightpath segment.

1 25. The switching apparatus of claim 20, wherein the resource reservation request
2 message comprises a *Path* message having a format based on an extension to the RSVP-TE
3 (ReSerVation Protocol – Traffic Engineering) signaling protocol.

1 26. The switching apparatus of claim 20, wherein the resource reservation response
2 message comprises a *Resv* message having a format based on an extension to the RSVP-TE
3 (ReSerVation Protocol – Traffic Engineering) signaling protocol.

1 27. The switching apparatus of claim 20, wherein execution of the instructions further
2 performs the operations of:
3 extracting a location of a third node coupled to the switching apparatus via a second
4 lightpath segment from the resource reservation request; and
5 forwarding the resource reservation request to the third node.

1 28. The switching apparatus of claim 20, wherein execution of the instructions further
2 performs the operations of:
3 determining if sufficient resources are available to support communication via the
4 first lightpath segment for the scheduled timeframe; and

5 generating an error message if it is determined that there are not sufficient resources
6 available.

1 29. The switching apparatus of claim 20, wherein said at least one processor includes a
2 network processor.

1 30. The switching apparatus of claim 20, wherein said at least one processor further
2 includes a control processor.

1 31. A machine-readable medium to provide instructions, which when executed by a
2 processor in a switching apparatus comprising a first node in an optical switched network,
3 cause the switching apparatus to perform operations comprising:

4 receiving a resource reservation request from a second node, said resource reservation
5 request including data pertaining to a lightpath segment between the second node and the
6 switching apparatus and a scheduled time period for which resources for the switching
7 apparatus are requested to be reserved to support communication via the lightpath segment;

8 determining if resources are available to support communication via the lightpath
9 segment during the scheduled time period, and if so,

10 making a soft reservation of resources supporting communication via the first

11 lightpath segment for the scheduled time period;

12 receiving a reservation response; and

13 changing the soft reservation of the resources supporting communication via
 14 the first lightpath segment to a hard reservation to commit the resources for the
 15 scheduled time period.

1 32. The machine-readable medium of claim 31, wherein execution of the instructions
 2 further performs the operations of:
 3 storing resource reservation data on a storage device operatively coupled to the
 4 processor, said resource reservation data including resource reservation status indicia
 5 indicating whether a resource has a corresponding soft or hard reservation.

1 33. The machine-readable medium of claim 31, wherein execution of the instructions
 2 determines whether adequate resources are available at a given node by performing
 3 operations including:
 4 aggregating any existing reservations for the node resource corresponding to a
 5 specified bandwidth and the scheduled time period to obtain an existing resource allocation;
 6 adding the bandwidth percentage corresponding to a resource reservation request to
 7 the existing resource allocation to obtain a requested allocation for the node resource; and
 8 determining if the requested allocation exceeds a threshold.

1 34. The machine-readable medium of claim 31, wherein the optical switched network
 2 comprise a wavelength-division multiplexed (WDM) photonic burst switched (PBS)
 3 network.